



How Network Openness and Reciprocity Drive Financial Performance Considering Environmental Uncertainty

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Abstract

Purpose: Effective network management will be essential for B2B companies as they navigate the challenges of today's fast-changing global business landscape. This study seeks to propose effective strategies that help B2B companies develop competitive advantages and attain sustainable growth by optimizing their networks in uncertain environments. **Research design, data and methodology:** This study suggests that network openness and network reciprocity affect the firm's financial performance, and that these effects may vary according to the level of environmental uncertainty. The hypotheses were tested with data collected using a cross-sectional survey of plant engineering network. The gathered data was analyzed by multiple regression analysis using the STATA program **Results:** The results of Model 1 indicate that both network openness and network reciprocity have positive effects on financial performance. In Model 2, environmental uncertainty strengthens the positive effect of network openness on financial performance, but reduces the positive impact of network reciprocity. These findings suggest that environmental uncertainty influences a firm's financial performance. **Conclusions:** This study offers both theoretical and practical insights. Although network structure is considered a key factor, its subjective nature poses challenges in measurement, and the cross-sectional design introduces certain limitations. Future research should investigate different applicable directions building on the findings of this study.

Keywords : Network Structure, Network Openness, Network Reciprocity, Financial Performance, Environmental Uncertainty

JEL Classification Code: M10, M21, M31

1. Introduction

The global business environment today presents unprecedented uncertainty and complexity for B2B companies (Moi & Cabiddu, 2022; Sharma et al., 2020). Key factors contributing to this situation include prolonged US-China trade tensions, the ongoing Russia-Ukraine war leading to volatility in energy and raw material prices,

inflationary pressures (Abate & Asaye, 2024), disruptions caused by the COVID-19 pandemic (Khan et al., 2022), geopolitical instability, supply chain disruptions, and the acceleration of technological innovation (Subhash, 2022).

In this environment of uncertainty, the importance of B2B networks is becoming more pronounced (Sepulveda & Gabrielsson, 2013; Vargo & Lusch, 2011). These networks have evolved beyond simple transactional relationships into

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complex ecosystems that enable companies to share information, distribute risks, and identify new opportunities (Huggins, 2010). Especially in uncertain conditions, such networks play a crucial role in helping firms respond with greater flexibility (Achrol & Kotler, 1999; Luo, 2003).

However, networks do not always yield positive outcomes (Burt, 2013). Power imbalances, over-dependence, and opportunistic behavior can emerge within networks, negatively impacting company performance (Ysa et al., 2014). Therefore, it is essential for B2B companies to develop the ability to effectively build and manage their networks (Ritter, 1999), as managing network capabilities can be a key factor in improving performance under uncertain conditions (Anser et al., 2021; Yang & Liu, 2012).

Recent research indicates that the performance of B2B companies is positively influenced by capabilities, open innovation, and network relationships (Homburg & Tischer, 2023; Lee & Kim, 2024). Furthermore, the interest of potential buyers is closely tied to the relationship between supplier capabilities and B2B performance (Ford & Mouzas, 2010). This suggests that as B2B platform visibility increases, buyers can observe each other's behaviors, leading to the formation of information cascades or herd effects, similar to those seen in personal social networks. Such dynamics in B2B markets amplify the importance of effectively managing network relationships to optimize performance (Feng et al., 2024).

In light of these findings, firms can better navigate uncertainties, optimize their networks, and improve performance in both developed and emerging markets by leveraging these capabilities and innovations (Lopez-Vega & Lakemond, 2022). A comprehensive approach to network management will be crucial for B2B companies as they face the complexities of today's rapidly evolving global business environment (Barczak et al., 2021).

This research aims to present practical strategies that enable B2B companies to create competitive advantages and achieve sustainable growth through network optimization in uncertain environments. Additionally, from an academic perspective, it seeks to propose a new theoretical framework that integrates B2B network theory with uncertainty management theory, offering both practical and scholarly contributions to the field.

2. Literature Review

2.1. Network Structure

The role of networks in industries has been widely studied, particularly with a focus on networks and relationships (Batjargal & Liu, 2004; Hite, 2005; Jack & Anderson, 2002; Lee & Tsang, 2001; Tsai, 2001; Uzzi, 2018;

Yli-Renko & Autio, 1998). Organizations that hold diverse positions and maintain broad connections within industrial networks gain unique opportunities to secure resources and capital through interaction and communication (Blau, 2017). In B2B industries, forming connections with other organizations grants access to valuable information, resources, and essential knowledge. The significance of network structures within industrial networks, as well as the importance of cooperative relationships, has been explored in prior research (Shipilov (Ahuja, 2000; Bell & Zaheer, 2007; Shipilov, 2009; Tsai, 2001; Wu et al., 2008). Building on these studies, we examine network structures from two key perspectives: openness and reciprocity.

2.1.1. Network Openness

Network openness is a pivotal role in the success of the focal company in business to business industry (Chesbrough, 2003; Greis et al., 1995). The concept of openness and network dynamics has been a subject of extensive research, with various perspectives offering insights into its nature and impact on the performance. Openness is generally viewed as a continuum between closed and open parties between focal company and exchange parties (Laursen & Salter, 2006). The degree of openness can be defined and measured in different ways, depending on the researcher's perspective and focus (Laursen & Salter, 2006; Leiponen & Helfat, 2010).

Network openness, for instance, is often characterized by three key factors: network membership diversity, willingness to accept new members, and the ties with network relationship (Choi & Lee, 2012; Romanelli & Khessina, 2005; Zaheer & George, 2004). This multifaceted approach recognizes that networks with diverse and fluid membership can access a wider range of information and resources (Breschi & Malerba, 2001), facilitating product development and market knowledge building. Empirical studies have supported this view, showing positive relationships between network heterogeneity and innovation levels, as well as the acquisition of competitive capabilities (McEvily & Zaheer, 1999; Rodan & Galunic, 2004).

In the context of innovation processes, researchers have proposed various frameworks to understand and measure openness (Laursen & Salter, 2006; Lichtenthaler, 2008; Park, 2024). Lichtenthaler (2008) defined openness by considering both inbound and outbound processes, focusing on external technology acquisition and exploitation. However, a widely adopted approach is that of Laursen and Salter (2006), who introduced the concepts of breadth which is number of external sources used and depth which is intensity of collaboration with each source. This framework has been influential in subsequent studies, with researchers often categorizing innovation partners into groups such as universities, research centers, customers, suppliers, and

competitors (Bengtsson et al., 2015; Lazzarotti et al., 2011). The intensity of collaboration, or depth, has emerged as a key factor in understanding the degree of openness (Lazzarotti et al., 2017; Xiaobao et al., 2013). This reflects how intensively a firm engages in external relationships to share knowledge and sustain innovation in dynamic environment. Recent studies have particularly focused on the depth of collaboration with scientific partners and business partners, recognizing the distinct contributions each type can make to the innovation process.

Importantly, research has shown that openness and diverse network connections can lead to improved performance outcomes (Gulati, 1998; Uzzi, 1996). Studies have found positive relationships between knowledge heterogeneity in networks and innovation levels, as well as between diverse information access and the acquisition of competitive capabilities (Cohen & Levinthal, 1990; Hitt et al., 1998). The success of many clusters around the world has been attributed, in part, to their international linkages and their ability to merge insights, skills, and technologies from various fields (Feldman, 1994; Porter, 1998). Based on the literature on openness in network dynamics, it is described as the degree of acceptance of new members to its network of exchange partners in the cluster (Eisingerich et al., 2010). Therefore, it influences the financial performance that is related to network structure (Eisingerich et al., 2010; Uzzi, 1996).

2.1.2. Network Reciprocity

In social exchange theory, reciprocity plays a central role, yet it has often been overlooked in relational exchange models (Blau, 2017; Kim, 2018). This concept posits that when one firm voluntarily provides benefits to a business partner, it creates an expectation of reciprocation, fostering a cycle of mutual benefit (Whitener (Whitener et al., 1998). Morgan and Hunt (1994) used this principle as a foundation for their commitment-trust theory of relational exchange.

While reciprocity is fundamental to social exchange theory, many studies on relational exchange have not explicitly included it in their conceptual or empirical models (Dyer et al., 2006; Johnson & Sohi, 2001). Despite these implicit recognitions, explicit inclusion of reciprocity as a distinct construct in relational exchange models remains uncommon. Johnson and Sohi (2001) made a notable exception by explicitly including reciprocity as a dependent variable in their conceptual model, distinguishing it from information exchange. Building on this foundation, there is an opportunity to further investigate the antecedents and consequences of reciprocity in socially governed exchange relationships, addressing a gap in the current literature on relational exchange (Dyer et al., 2006; Morgan & Hunt, 1994).

Relational proclivity refers to a firm's general tendency

to seek out, engage in, and develop close partner-style interfirm relationships, as opposed to maintaining arm's-length transactions (Larson, 1992; Rotter, 1967). Despite the potential benefits of closer partnerships, some firms are reluctant to build such relationships, preferring to keep interactions at arm's length (Dyer et al., 2006; Mohr & Spekman, 1994). This variation in approach suggests that firms, like individuals, differ in their propensity for close relationships (Larson, 1992; Rotter, 1967). This tendency exists independently of any specific partner or prior information about potential partners (Rotter, 1967). It may be rooted in various factors, with the propensity to trust likely playing a significant role (McKnight & Chervany, 2001; Rotter, 1967). Strong relational proclivity can stem from beliefs that partnerships enhance outcomes or general preferences for collaborative projects (Dyer et al., 2006; Morgan & Hunt, 1994). It indicates the existence of a partnership philosophy within the firm (Mohr & Spekman, 1994).

Conversely, weaker relational proclivity, where firms tend to avoid close and deep associations with interfirm relationship partners, may be rooted in fears of exploitation, deception, or other forms of opportunism (Ring & Van de Ven, 1994; Rousseau et al., 1998). It could also simply reflect discomfort with sharing decision-making domains (Dyer et al., 2006; Mohr & Spekman, 1994).

The concept of relational proclivity helps explain why, despite potential benefits, some firms maintain arm's-length relationships while others actively pursue closer partnerships (Dyer et al., 2006; Larson, 1992). This variation in approach can significantly impact a firm's strategy and performance in interfirm relationships (Johnson & Sohi, 2001; Morgan & Hunt, 1994).

2.2. Environmental Uncertainty

Some scholars have addressed the effectiveness of organizational relationships that depend upon the fit between external environmental components and a firm's internal resources (Lo & Shiah, 2016; Neu & Brown, 2005; Yoon & Kim, 2024). In such research, according to contingency theory, environmental uncertainty is a crucial factor for interfirm management strategies (Lee, 2002; Lo & Shiah, 2016).

Environmental uncertainty refers to the inability to predict changes in relevant factors surrounding suppliers' exchanges (Walker & Weber, 1987). In this regard, when environmental uncertainty increases, expectations such as the development of future supply requirements also increase in the gap between goals and performance (Kim, 2023). In addition, suppliers are likely to insist on negotiating agreements that account for price uncertainty and the inability to predict demand for products (Kim & Kim, 2022;

Walker & Weber, 1987). Such a requirement makes it more difficult for suppliers to negotiate contracts. Consequently, suppliers may spend significant time and effort on detailed contracts because of unfavorable environmental changes (Walker & Weber, 1987). Similarly, some studies have argued that environmental uncertainty comes from a lack of clear understanding of the situations that firms encounter. Such uncertainty occurs when parties perceive that their environment, or one of its factors, is unpredictable in the market (Duncan, 1976; Milliken, 1987). Other studies have addressed the issue that environmental uncertainty is created by the perceived rate of changes and the ability to understand causes and relationships (Boyd & Fulk, 1996; Priem et al., 1995; Yu et al., 2016). Specifically, Yu, Wang, and Brouthers (2016) theorized that perceived environmental uncertainty affects a firm's willingness and ability to identify parties. Consequently, higher environmental uncertainty occurs in the market and the more straitened firms try to minimize resource commitments regarding money, time, and effort.

In order to identify each partner, firms should acquire interfirm relationships through network embeddedness, cooperation, and trust when under conditions of environmental uncertainty (Birnberg, 1998; Min et al., 2015; Poppo & Zenger, 2002). For example, when environmental uncertainty increases the exchange parties' potential for opportunism, it is hard to control and anticipate market demand because of the changing external environment (Birnberg, 1998; Poppo & Zenger, 2002). In this situation, environmental uncertainty should be positively affected by exchange partners' opportunism and negatively influenced by exchange partners' benevolence (Birnberg, 1998; Poppo & Zenger, 2002). Moreover, environmental uncertainty allows each exchange partner to act candidly in its own interest and take advantage of an uncertain situation (Klein et al., 1990). When an exchange partner does not trust its business associates because of a lack of honesty, flexible behavior is difficult because the exchange partner does not believe the information that a firm provides. From this perspective, when a firm has perceived honesty is low, there is no relationship with exchange partners (Min et al., 2015).

In this study, environmental uncertainty is defined as a core factor of interfirm relationships in networks. Thus, it influences the financial performance that is related to network structure by moderating factor in interfirm relationships

2.3. Financial Performance

Financial performance is a crucial indicator of a company's overall health and competitiveness in the industrial sector (Brigham, 2013; Merchant & Van der Stede, 2017). It encompasses various metrics that measure

profitability, efficiency, and value creation for shareholders (Brigham, 2013; Kaplan & Norton, 1996). Larger firms often have advantages in terms of resource access and economies of scale, which can positively impact their financial performance (Barney, 1991; Penrose, 2009; Shirzad et al., 2015). However, the relationship between firm size and financial outcomes is not always straightforward, as larger companies may also face unique challenges and risks (Rumelt, 1991).

The capital structure of a company, which refers to its mix of debt and equity financing, plays a significant role in determining financial performance (Modigliani & Miller, 1958; Myers, 2001). Liquidity, or a firm's ability to meet short-term obligations, is another critical factor that affects financial health and is often measured using ratios such as the current ratio and acid-test ratio (Brigham & Houston, 2013; White et al., 2002). Operational efficiency, as reflected in metrics like inventory turnover and total asset turnover, can have a substantial impact on a company's financial results (Kaplan & Norton, 1996; Porter, 1991).

In recent years, there has been growing interest in the relationship between lean manufacturing practices and financial performance (Womack et al., 2007). For recent research studies, it's important to note that the success of lean practices in enhancing financial performance depends on proper implementation and alignment with organizational goals (Liker & Choi, 2004; Womack & Jones, 2003). The literature also highlights the importance of considering non-financial performance measures alongside traditional financial metrics (Ittner & Larcker, 1998; Kaplan & Norton, 2005). Non-financial indicators can serve as leading indicators of future financial performance and provide a more comprehensive view of a company's overall health (Eccles, 1991; Kaplan & Norton, 1996). The Balanced Scorecard approach, which integrates both financial and non-financial measures, has been associated with improved performance outcomes in many industrial contexts (Kaplan & Norton, 1996; Niven, 2002).

In this study, financial performance is defined as a core factor of interfirm relationships in networks (Gulati, 1998; Uzzi, 1996). Thus, it is affected by openness and reciprocity in network structure as moderating factors in interfirm relationships (Dyer & Singh, 1998; Gulati, 1998; Uzzi, 1996).

3. Hypotheses Development

3.1. Network openness and financial performance

Network openness is one of key factors for business-to-business relationship. Network openness and connections between firms, both domestically and internationally,

provide benefit between more partners (Bernard & Moxnes, 2018). That means how network structures impact trade relationships and choices in network relationship. The network perspective provides insight into the broader benefits of openness (Duernecker et al., 2022). Especially, It highlights how network openness and position can provide more options for partnerships (Gold et al., 2020). Openness can impact growth and trade opportunities (Yanikkaya, 2002).

Network openness plays a crucial role in enhancing the strategic advantages of a focal company by providing access to a wider array of trading partners. In an open network environment, companies can explore more diverse options, which increases the likelihood of partnering with more competitive firms (Granovetter, 1985; Uzzi, 1996). Such networks facilitate the exchange of information and resources, contributing to the adoption of innovative solutions and improving overall business performance (Gulati, 1998). Therefore, network openness not only broadens the range of choices but also positively impacts financial performance by enabling companies to select the most suitable partners.

Particularly, the more open a network, the better a focal company can evaluate and compare the capabilities of various trading partners (Wasserman, 1994). This creates a favorable environment for selecting partners that align closely with the company's strategic goals, thereby maximizing performance (Burt, 1992). For instance, businesses can choose partners offering more competitive terms, such as better cost structures or advanced technical capabilities, which ultimately contributes to improved outcomes (Dyer & Singh, 1998).

Moreover, network openness fosters competition among trading partners, allowing the focal company to receive better services and higher-quality products. As suppliers compete to collaborate with the focal company, the company can negotiate more favorable conditions (Powell, 1992; Rowley et al., 2000). This increased competition leads to cost reductions and efficiency improvements, which significantly enhance the focal company's financial performance.

Network openness helps companies avoid over-dependence on a single trading partner by distributing risk across multiple suppliers. By collaborating with a diverse range of suppliers, the focal company can mitigate supply chain risks and reduce the negative impacts of any disruptions (Choi & Krause, 2006; Gulati, 1998). Stable supply chain management contributes to cost reduction and revenue stabilization, further strengthening financial outcomes.

Network openness enables focal companies to select optimal trading partners, leading to positive financial results. By partnering with more competitive firms, focal companies

can achieve cost savings, quality improvements, and operational efficiency, resulting in overall performance enhancement (Smith et al., 1995; Vargo & Lusch, 2004). Therefore, managing and maintaining network openness positively is affected to financial performance in B2B companies.

H1: Network openness will positively impact financial performance.

3.2. Network Reciprocity and Financial Performance

Reciprocity in networks plays a key role in building mutual trust between the focal company and its trading partners. Reciprocal relationships are based on a structure where all participants benefit, which in turn strengthens the stability of the trading relationship (Granovetter, 1985). In particular, reciprocity fosters higher levels of communication and cooperation between trading partners, increasing interdependence and forming the foundation for trust (Gulati, 1998). Trust-based networks allow companies to maintain cooperative relationships over the long term, which is essential for sustainable success.

Moreover, reciprocity enables the focal company to identify more suitable trading partners. In a network characterized by trust, companies can clearly understand each other's strengths and weaknesses, allowing for a more effective evaluation of each partner's resources and capabilities (Uzzi, 1997). This evaluation process helps the focal company select partners that align with its long-term strategic goals, ultimately contributing to the achievement of these goals (Dyer & Singh, 1998).

Additionally, reciprocal networks foster competition among trading partners while maintaining trust. Trading partners are incentivized to offer better conditions in order to maintain their trusted relationships with the focal company, which in turn allows the focal company to receive better quality products and services (Powell, 1992). This competitive cooperation leads to both cost reduction and operational efficiency improvements, positively impacting the financial performance of the focal company (Rowley et al., 2000).

Reciprocity also contributes to risk distribution among companies. In trusted networks, the focal company can collaborate with a diverse set of trading partners, reducing dependence on any one supplier and improving supply chain stability (Choi & Krause, 2006). This reduces potential risks in the supply chain and supports the company's sustainable growth.

Reciprocal networks significantly improve the financial performance of the focal company. Trust-based relationships enable stronger partnerships, which lead to

better cost-saving opportunities, quality improvements, and enhanced operational efficiency (Smith et al., 1995). Therefore, reciprocity in networks is positively impacts the financial success and competitive advantage of businesses.

H2: Network Reciprocity will have a positive effect on performance.

3.3. Network Openness and Environmental Uncertainty on Financial Performance

Companies increasingly prioritize network relationships to effectively cope with uncertainty, in recently. This shift is driven by the need to share information and secure essential resources through collaboration and trust within their networks (Park et al., 2017). Particularly in uncertain environments, companies actively seek external and non-financial information from diverse sources and partners within their networks. This behavior underscores the importance of a broad range of information sources, which helps companies navigate volatile conditions (Dwirandra & Astika, 2020).

The open networking behavior of companies, which involves collaborating with a wide variety of partners, plays a key role in accessing a broader array of external information and resources (Franco & Martins, 2023; Park et al., 2017). Network openness, both domestically and internationally, enables companies to benefit from an expanded range of partnerships and resource-sharing opportunities (Bernard & Moxnes, 2018). The network perspective provides valuable insights into the benefits of openness, particularly by expanding partnership options and enhancing resource acquisition (Duernecker et al., 2022).

For focal companies, network openness means adopting a more inclusive and open stance towards all potential trading partners. By maintaining this openness, companies can more easily access the resources, knowledge, and information available within the network. This access generally contributes to better financial performance, as it simplifies the process of finding suitable trading partners (Bernard & Moxnes, 2018). As companies effectively leverage the diverse resources of their networks, they are better positioned to optimize their strategic partnerships, leading to improved financial outcomes (Park et al., 2017). Thus, network openness plays a crucial role in enhancing both the operational flexibility and financial performance of companies operating in uncertain environments.

H3: The greater the environmental uncertainty, the more positive will be the effect of network openness on the firm's financial performance. Specifically, as environmental uncertainty increases, the positive impact of network openness on performance will be strengthened.

3.4. Network Reciprocity and Environmental Uncertainty on Financial Performance

Network reciprocity generally enhances trust and cooperation between companies, which positively affects performance. Relationships built on mutual benefit promote the sharing of resources and the exchange of information, enabling companies to make better decisions that support innovation and competitiveness (Gulati, 1995; Yue et al., 2022). Particularly, when companies can leverage the shared resources within a network, they can identify new opportunities and respond more flexibly to market changes, making network reciprocity a crucial factor in improving financial performance (Choi & Storr, 2020; Dyer & Singh, 1998). The ability to utilize resources efficiently and capitalize on innovation and growth opportunities is a key advantage of such cooperative networks (Burt, 1992).

However, as environmental uncertainty increases, the positive effects of network reciprocity can diminish. When uncertainty grows, companies find it more difficult to predict the behavior of their partners, which increases the risk of opportunistic behavior (Park et al., 2017; Williamson, 1998). With trading partners likely to prioritize their own interests, companies tend to withhold resources, opting for internal retention rather than sharing them within the network. This undermines trust and limits the flow of resources and information, leading to more passive cooperation between firms (Gulati & Gargiulo, 1999).

In highly uncertain environments, firms may focus on monopolizing resources, weakening collaborative efforts, and negatively impacting long-term performance (Choi & Storr, 2020; Uzzi, 1997). In such situations, companies may lose opportunities for innovation and struggle to respond to market dynamics, which ultimately threatens their competitiveness. Therefore, maintaining trust and cooperation through strategic approaches becomes even more critical in uncertain environments (Dyer & Singh, 1998).

Environmental uncertainty can negatively affect interfirm collaboration, and this can subsequently harm financial performance. When trust erodes, firms shift their focus from collaboration to independent operation, which hinders the efficient use of resources and increases operational costs (Gulati, 1995; Yue et al., 2022). Network reciprocity is more effective in environments with lower uncertainty, where trust and cooperation between firms can flourish, leading to improved performance. However, as uncertainty rises, the positive effects of collaborative networks may wane, and firms may become more reluctant to share resources. Thus, network reciprocity will be weakened in high environmental uncertainty in B2B industries.

H4: The greater the environmental uncertainty, the more negative will be the effect of network reciprocity on the focal firm's financial performance. Specifically, as environmental uncertainty increases, the positive impact of network reciprocity on performance will be weakened.

4. Research Methods

Based on these hypotheses, this study suggests that network openness and network reciprocity affect the firm's financial performance, and that this may vary depending on the level of environmental uncertainty. We have constructed the following model.

Network structure

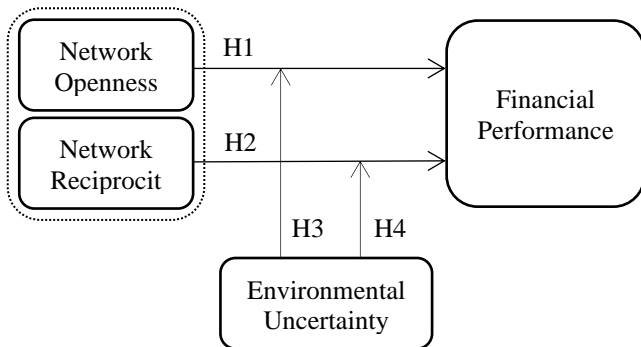


Figure 1: The Effect of Network Openness and Reciprocity on the Financial Performance According to the Environmental Uncertainty

4.1. Data Collection and Method

The hypotheses were tested with data collected using a cross-sectional survey of plant engineering network (manufacturer-1st supplier- 2nd supplier) in Korea. In this study, buyers are the primary suppliers of large Korean engineering companies (plant manufacturing companies), while sellers are the suppliers to those primary suppliers (i.e., second-tier suppliers to the manufacturing company). We collect mail survey distributed to the first suppliers of Korean engineering companies. Contact information of the first suppliers was obtained from engineering companies with the cooperation of managers working for the engineering companies.

We intended to apply multi-item measures from previous research however adjusted some questions to improve respondents' comprehension. After initially selecting the items, we sent the survey to some of buyers to ensure they understood all questions and items clearly. Revisions were made based on their feedback, and after several rounds of refinement, the final set of items was

confirmed. Surveys were distributed to 500 respondents, with 149 (30%) providing responses. Of these, 10 were excluded due to incomplete answers, resulting in 139 valid samples for analysis. Each survey was mailed with a cover letter outlining the purpose of the study.

4.2. Measures

We developed existing measures based on the definitions of constructs and previous research to capture all constructs in this study. To refine the draft questionnaire, we conducted in-depth interviews with professionals in the plant engineering industry and other relevant stakeholders. The questionnaire was designed to assess specific manifest variables, with all items measured on a seven-point Likert scale, ranging from 1 (extremely disagree) to 7 (extremely agree).

We selected appropriate question items for each measurement variable through exploratory factor analysis (EFA). The measurement values of the selected items were averaged and used as the variable values.

Table 1: Factor Analysis

Variable	Component			
	1	2	3	4
Financial Performance 1	.206	.853	.102	.117
Financial Performance 2	.305	.824	.149	.142
Financial Performance 3	.437	.683	.096	.163
Network Openness 1	.022	.084	.153	.809
Network Openness 2	.026	.369	.127	.746
Network Openness 3	.335	-.065	-.088	.706
Network Openness 4	.362	.415	-.077	.518
Network Reciprocity 1	.837	.231	.074	.125
Network Reciprocity 2	.784	.308	.144	.208
Network Reciprocity 3	.763	.284	.187	.141
Network Reciprocity 4	.649	.405	.287	.086
Environment Uncertainty 1	.290	.120	.816	.046
Environment Uncertainty 2	.201	.097	.797	.062
Environment Uncertainty 3	-.127	.078	.650	.003
Environment Uncertainty 4	.484	.007	.630	.104

4.3. Independent Variable: Network Structure

Previous studies have shown that network structures between focal firms and partners are crucial as they play a key role in promoting interfirm synergistic effects (Fang et al., 2017; Heidl et al., 2014). Therefore, network structure is a critical component of interfirm relationship, as it is

embedded within a network of mutual connections. In particular, how open the relationships with other companies are, the extent of mutual dependence, and the level of reciprocity between companies are crucial factors in network relationships. We measured two types of network structures: Network openness and Network reciprocity.

4.3.1. Network Openness

Network openness refers to the diversity of members within the network, the willingness to accept new members into our network structure, and the degree of external connections with organizations beyond the network (Eisingerich et al., 2010). This study derived the survey items for measuring network openness from previous research and refined them to suit the objectives of this study (e.g., Eisingerich et al., 2010; Romanelli & Khessina, 2005; Zaheer & George, 2004). This study measured network openness using the following questions: "The selection of our company's suppliers is open to all companies," "The selection of our company's suppliers is not limited to existing partners," "The selection of our company's buyers is open to all companies," and "The selection of our company's buyers is not limited to existing partners.". Cronbach Alpha was at 0.74, demonstrating high level of reliability.

4.3.2. Network Reciprocity

Network reciprocity refers to the mutually beneficial exchange of resources, support, or information between network participants. This concept plays a critical role in fostering cooperation and trust within business relationships. It implies that companies involved in a network are more likely to engage in reciprocal actions, such as sharing valuable insights or helping each other, which in turn strengthens their connections and leads to long-term collaboration (Chen et al., 2009; Johnson & Sohi, 2001; Yamauchi et al., 2010). In this study, as with previous variables, survey items were drawn from existing research and then modified to fit the objectives of this research. We measured network reciprocity using the following questions. "The favorable business actions of our buyers and suppliers motivate us to put forth our best effort in maintaining relationships with them.", "Our buyers and suppliers always helps and supports us and we do likewise.", "We provide various conveniences to our buyers and suppliers, and they reciprocate with similar benefits.", "Our buyers and suppliers expect help and support from us, and we likewise help and assist them." Cronbach Alpha was at 0.89, demonstrating high level of reliability.

4.4. Dependent variable: Financial Performance

Financial performance is an important indicator of a

company's competitiveness. It reflects not only the evaluation of the company's operational efficiency and profitability but also how well it creates value for shareholders. Therefore, financial performance was considered to assess the role of network structure within the company. Below survey questions were used for financial performance: "Our company and its buyers and suppliers have achieved greater benefits than we could have accomplished with other potential partners.", "The cooperation between our company and its buyers and suppliers has increased our profits." and "Our company has achieved greater benefits through cooperation with its buyers and suppliers compared to when we did not cooperate with them.". Cronbach Alpha was at 0.86, demonstrating high level of reliability.

4.5. Moderation Variable: Environmental Uncertainty

Environmental uncertainty refers to the unpredictability of external conditions that may affect an organization's decision-making and strategies. It can stem from various factors such as market fluctuations, competitive intensity, regulatory changes, and technological turbulence (Freel, 2005; Kohli & Jaworski, 1990; Lee et al., 2009). This study measured a company's environmental uncertainty through the following questions: "The size of the industry our company belongs to remains constant.", "Our company's sales forecasts are generally accurate.", "Our company can obtain sufficient information for making marketing decisions." and "Our company's sales forecasts will be accurate.". Cronbach Alpha was at 0.73, demonstrating high level of reliability.

5. Analysis and Results

Table 2 presents correlations between variables and Table 3 shows estimation results. Model 1 includes only main variables and Model 2 includes all interaction terms to test our hypotheses.

Model 1 shows direct effect of network openness and network reciprocity on financial performance. The result revealed that higher network openness enhances financial performance ($\beta = 0.199$, $p < 0.01$), which is consistent with Hypothesis 1. Also, network reciprocity increases firm's financial performance ($\beta = 0.620$, $p < 0.01$), supporting hypothesis 2. Further, environmental uncertainty has no impact on the firm's financial performance ($\beta = 0.026$, n.s.).

We test our Hypothesis 3 and 4 through Model 2 which includes the interactions. The positive effect of network openness on financial performance becomes greater as environmental uncertainty increases ($\beta = 0.120$, $p < 0.05$),

which is consistent with Hypothesis 3. Also, environmental uncertainty decreases the positive effect of network reciprocity on financial performance, supporting Hypothesis 4 ($\beta = -0.233, p < 0.01$).

Table 2: Correlation Table

Constructs	1	2	3	4
1. Financial Performance	1.000			
2. Network Openness	0.457	1.000		
3. Network Openness	0.664	0.451	1.000	
4. Environmental uncertainty	0.321	0.194	0.468	1.000

Table 3: Results Table

Variables	Model 1		Model 2	
	β	SE	β	SE
Network Openness	0.199***	(0.068)	-0.153	(0.184)
Network Reciprocity	0.620***	(0.086)	1.414***	(0.191)
Environmental Uncertainty	0.026	(0.085)	0.234	(0.209)
Network Openness X Environmental Uncertainty			0.120**	(0.059)
Network Reciprocity X Environmental Uncertainty			-0.233***	(0.054)
Constant	0.444	(0.292)	-0.358	(0.652)
Observations	139		139	
R-squared	0.466		0.503	
r2_a	0.454		0.485	

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

6. Conclusion and Discussion

6.1. General Discussion and Implication

The study examined the impact of network openness and network reciprocity on financial performance in presence of environmental uncertainty. It empirically illustrates how environmental uncertainty influence differently based on network relationship. Contrary to previous network studies, findings reveal that openness enhances financial performance in network relationship. When network openness involves the importance of openness in exchange relationship, ultimately raise up in financial performance. Additionally, increased network openness and reciprocity instead of responding in isolation, firms collaborate with more suppliers and develop their network relationships further.

The moderating effect of environmental uncertainty plays a critical role in interfirm network relationships. As

confirmed in this study, environmental uncertainty influences the effectiveness of network openness and reciprocity, with access to new information and resources becoming increasingly important for firm performance in highly uncertain environments. However, in collectivist cultures where 'in-group' preferences are strong, such as in societies with high familiarity-based transactions (Xiao & Tsui, 2007), dealing with familiar partners can have a positive effect by reducing opportunism and fostering trust. At the same time, this reliance on familiar relationships may limit access to new external information and resources, posing potential risks. Therefore, in the presence of environmental uncertainty, this suggests that firms need a balanced approach to forming new external relationships and continuously acquiring relevant information.

6.1.1. Theoretical Contribution

This study makes a significant theoretical contribution by extending the understanding of how network openness and reciprocity impact financial performance, particularly in environments characterized by uncertainty. Prior research has largely focused on the direct benefits of open networks and reciprocal relationships, but this study offers a nuanced perspective by considering how environmental uncertainty moderates these relationships. By doing so, the paper builds on existing theories of network theory (Granovetter, 1985; Uzzi, 1997) and resource dependence (Pfeffer & Salancik, 1978), demonstrating that while network openness and reciprocity generally enhance financial performance, the effectiveness of these strategies is contingent on the degree of uncertainty in the external environment. This provides a more complex and dynamic understanding of the interplay between network structures and firm performance.

Furthermore, this research advances the theoretical discourse on inter-firm collaboration by integrating insights from both network theory and strategic management. The paper highlights that network openness is particularly beneficial under conditions of high uncertainty, where access to diverse resources and partners can help firms mitigate risks and seize opportunities. Conversely, the study challenges the commonly held view that reciprocity in networks always leads to better outcomes. It posits that in highly uncertain environments, the advantages of reciprocity may diminish as firms become more risk-averse and less willing to share resources. This finding adds to the literature by suggesting that the efficacy of reciprocal relationships is context-dependent, offering a more refined understanding of how firms should strategically approach collaboration (Dyer & Singh, 1998; Gulati, 1995).

Finally, the study makes a theoretical contribution by proposing and empirically testing two moderation hypotheses, H3 and H4, which examine the impact of environmental uncertainty on the relationship between

network openness, reciprocity, and financial performance. These hypotheses not only broaden the scope of network theory but also contribute to contingency theory, which posits that the effectiveness of certain strategies depends on external conditions (Lawrence & Lorsch, 1967). By providing empirical evidence for these moderating effects, the paper strengthens the case for adopting a contingency-based approach to inter-firm networks, thereby advancing both the network and strategic management literatures (Burt, 1992; Choi & Krause, 2006).

6.1.2. Managerial Contribution

From a managerial perspective, this study offers actionable insights for companies looking to enhance their financial performance through network strategies. One of the key takeaways is that firms should prioritize network openness, especially in uncertain environments. Managers are encouraged to build and maintain diverse networks of trading partners, both domestically and internationally, as this can provide access to a broader array of resources and information (Bernard & Moxnes, 2018). By doing so, firms can enhance their flexibility and adaptability, making them better equipped to navigate volatility. In practice, this means that managers should invest in relationship-building activities, attend industry events, and actively seek partnerships across different sectors and regions to optimize their network's openness (Duernecker et al., 2022).

Additionally, the study provides important guidance on how to manage reciprocal relationships in the face of environmental uncertainty. While reciprocal networks can enhance trust and cooperation, managers must be cautious about relying too heavily on reciprocity in uncertain environments. The findings suggest that as uncertainty increases, the risks associated with reciprocity, such as opportunistic behavior and resource hoarding, also rise (Park et al., 2017). To mitigate these risks, managers should adopt more formalized governance mechanisms, such as contracts and performance metrics, to ensure that reciprocity remains mutually beneficial even under challenging conditions (Gulati & Gargiulo, 1999). This strategic shift can help firms maintain the benefits of cooperation while safeguarding against potential downsides.

Finally, the study encourages managers to take a more dynamic approach to network management, particularly by considering how external factors like market volatility may affect their network strategies. Managers should regularly reassess the state of their external environment and adjust their network strategies accordingly. In highly uncertain markets, firms may benefit from placing more emphasis on openness and less on reciprocity, whereas in more stable conditions, reciprocal relationships can be leveraged for long-term collaboration and trust (Yue et al., 2022). By aligning network strategies with the external environment,

managers can better optimize their network's contribution to financial performance, leading to more resilient and successful organizations.

6.1.3. Limitations

This study presents several limitations. First, while environmental uncertainty is treated as a key moderating factor in the study, its measurement can be challenging due to its subjective nature. Environmental uncertainty can encompass a wide range of external factors, including market volatility, regulatory changes, technological advancements, and shifts in consumer behavior, all of which may influence how firms manage their network relationships. However, the degree of uncertainty can vary significantly across industries, regions, or even individual firms. For instance, industries such as technology or healthcare might experience higher levels of uncertainty due to rapid innovation and regulatory shifts, whereas more stable industries, like utilities or manufacturing, may face relatively lower uncertainty. Additionally, environmental uncertainty may be perceived differently by firms depending on their size, resources, or geographical location. The absence of a standardized approach to measuring environmental uncertainty across diverse settings could reduce the robustness of the study's conclusions. Developing more precise and universally applicable measures of uncertainty could strengthen the findings and provide clearer insights into how network openness and reciprocity function under different levels of external unpredictability.

Second, the study's reliance on a cross-sectional design presents limitations in capturing the long-term effects of network openness and reciprocity on financial performance. Cross-sectional studies provide a snapshot of relationships at a single point in time, which may not fully reflect how network strategies and their outcomes evolve over time. Network relationships, especially in B2B settings, tend to be dynamic and subject to changes due to external factors such as market conditions, technological disruptions, or shifts in partner capabilities. As firms engage in ongoing collaborations with multiple partners, the benefits of network openness and reciprocity may compound or diminish based on the stability and depth of these relationships. For example, trust between partners may deepen over time, leading to more efficient resource-sharing and higher levels of innovation, or it may erode due to competitive pressures or misaligned objectives. A longitudinal study, therefore, would offer a more comprehensive view of how network strategies impact financial performance over an extended period. By tracking these relationships over time, researchers could uncover critical patterns, such as how firms adapt their network strategies in response to environmental changes, and how

long-term partnerships influence sustained financial success. This approach would provide richer insights into the evolving nature of network dynamics and their enduring impact on organizational performance.

6.1.4. Future Research

Future research should explore multiple directions to build upon the findings of this study. First, future studies should investigate how network openness and reciprocity impact financial performance across various industries, including B2C and service-based sectors. Since the current research focuses on B2B industries, it is important to uncover the unique dynamics that may arise in different business environments. B2C industries, for example, often have shorter and more direct supply chains, where consumer-facing factors might influence network behaviors differently compared to the complex interdependencies seen in B2B contexts. By examining industry-specific factors, researchers can assess the broader applicability of these concepts and gain a deeper understanding of the distinct ways network openness and reciprocity contribute to financial performance across parties.

Second, future research could benefit from employing longitudinal designs to track the long-term impacts of network strategies on financial performance. A cross-sectional approach, as used in this study, offers only a snapshot of the relationships between network structures and outcomes. However, a longitudinal study would provide a more dynamic view, capturing how network strategies and their effects evolve over time. It could reveal how firms respond to shifts in the business environment, such as regulatory changes or market disruptions, and how long-term relationships with partners influence financial outcomes. For example, Gulati (1998) suggests that the stability and depth of alliances evolve, influencing trust and resource-sharing, which are critical to sustained financial success. By adopting this approach, researchers could offer richer insights into the adaptive nature of networks and their impact on long-term financial performance.

Lastly, cultural factors in global networks warrant closer examination. Cultural differences can profoundly influence how firms approach trust, reciprocity, and openness within networks, particularly in international partnerships. Different cultural norms regarding communication, negotiation, and relationship-building can alter the dynamics of network cooperation. Granovetter (1985) highlights the importance of embeddedness in social and cultural contexts, which suggests that network strategies may not operate uniformly across different cultural settings. Future studies should delve into how these cultural variations impact the efficacy of network openness and reciprocity, offering valuable insights for companies seeking to manage global B2B networks. Moreover, exploring how

firms navigate cultural barriers to foster trust and reciprocity in international partnerships could provide critical strategies for enhancing global collaboration.

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